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Thompson et al.

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(54) **SEAL CONFIGURATION FOR USE WITH A MOTOR DRIVE ASSEMBLY IN A MICROELECTRONIC WORKPIECE PROCESSING SYSTEM**

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(73) Assignee: **Semitool, Inc.**

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

This patent is subject to a terminal disclaimer.

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(22) Filed: **Feb. 14, 2000**

(51) **Int. Cl.**[7] **B08B 13/00**

(52) **U.S. Cl.** **134/140**; 134/157; 134/902

(58) **Field of Search** .... 134/902, 140, 134/153, 157, 159; 156/345 L, 345 LS

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6,098,641 A * 8/2000 Owczarz .... 134/902 X

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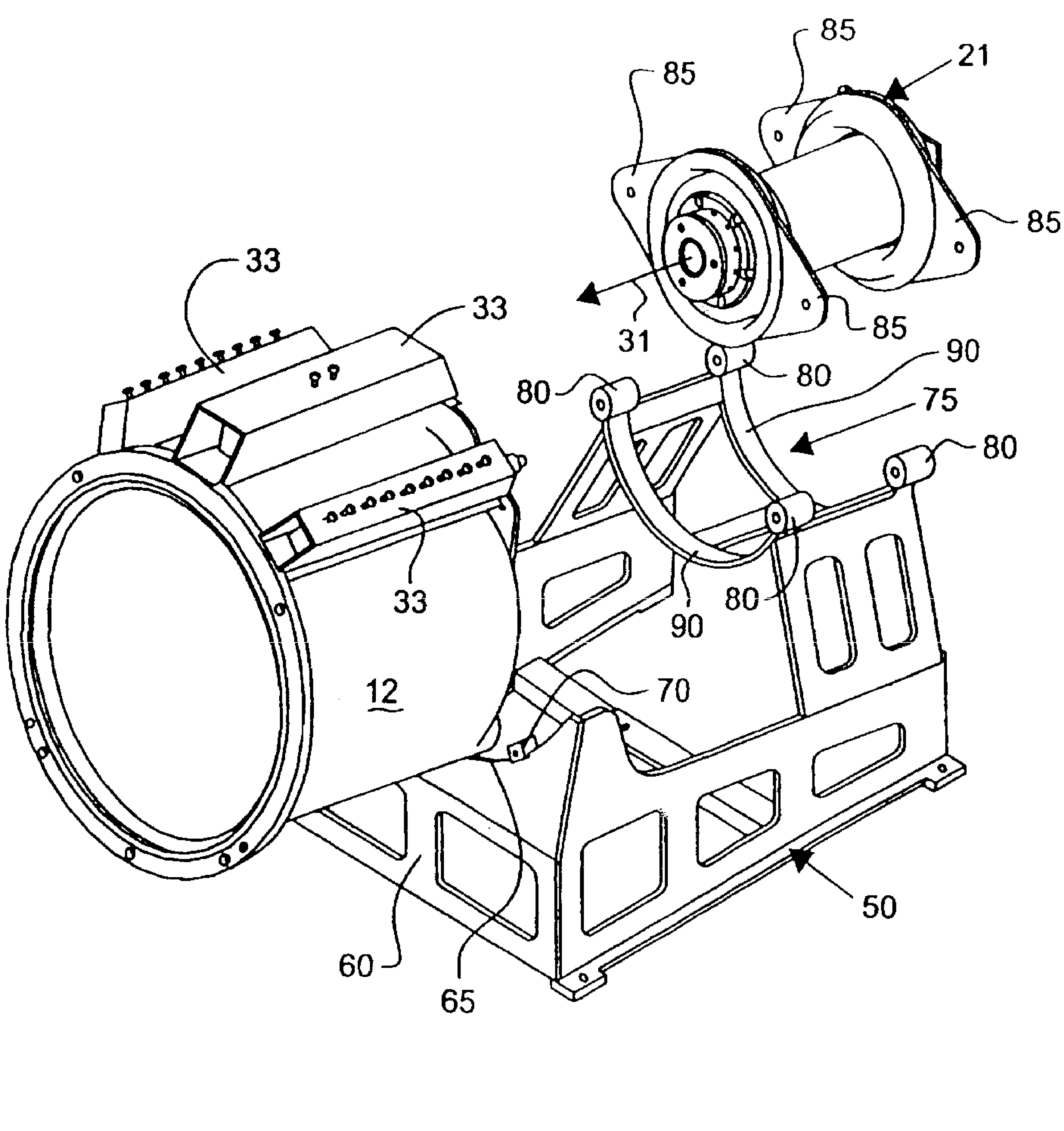
(57) **ABSTRACT**

An apparatus for processing a microelectronic workpiece, such as a semiconductor wafer, is set forth. The apparatus comprises a processing bowl that defines a processing chamber. A seal is provided to assist in removing fluids, such as processing fluids, from the processing chamber that are in the proximity of the seal. Further, the seal is provided to assist in preventing the fluids from entering the motor. To this end, flow generating threads and expulsion threads are provided at an end of a shaft assembly that is connected to be driven by the motor. A member substantially surrounds at least a portion of the flow generating threads and at least a portion of the expulsion threads. Together, the member defines a chamber with the shaft assembly. Rotation of the shaft assembly results in corresponding rotation of the flow generating threads and expulsion threads to drive fluids proximate the shaft assembly to an exhaust while concurrently assisting in preventing such fluids from entering the motor.

33 Claims, 7 Drawing Sheets



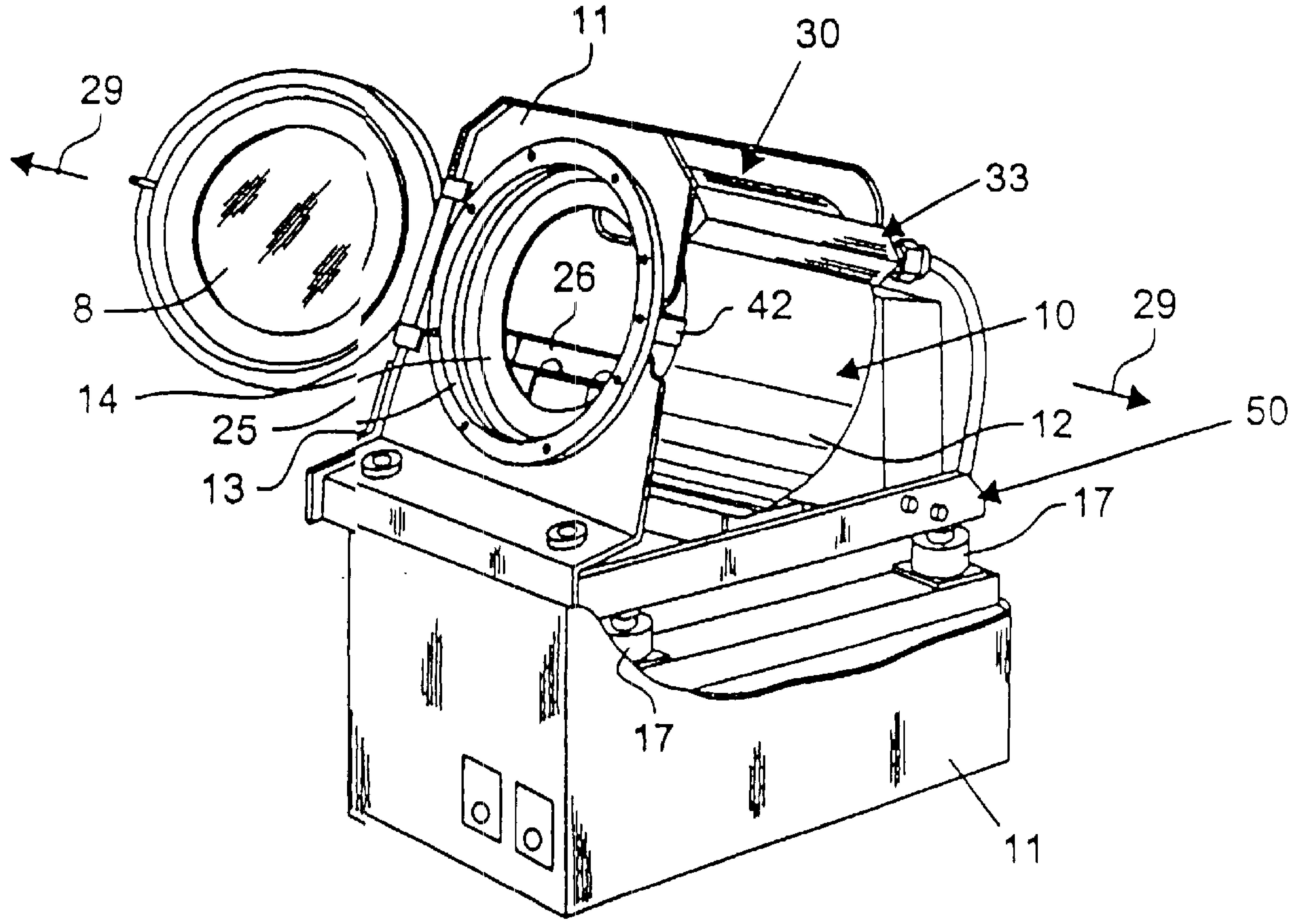

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Fig. 1

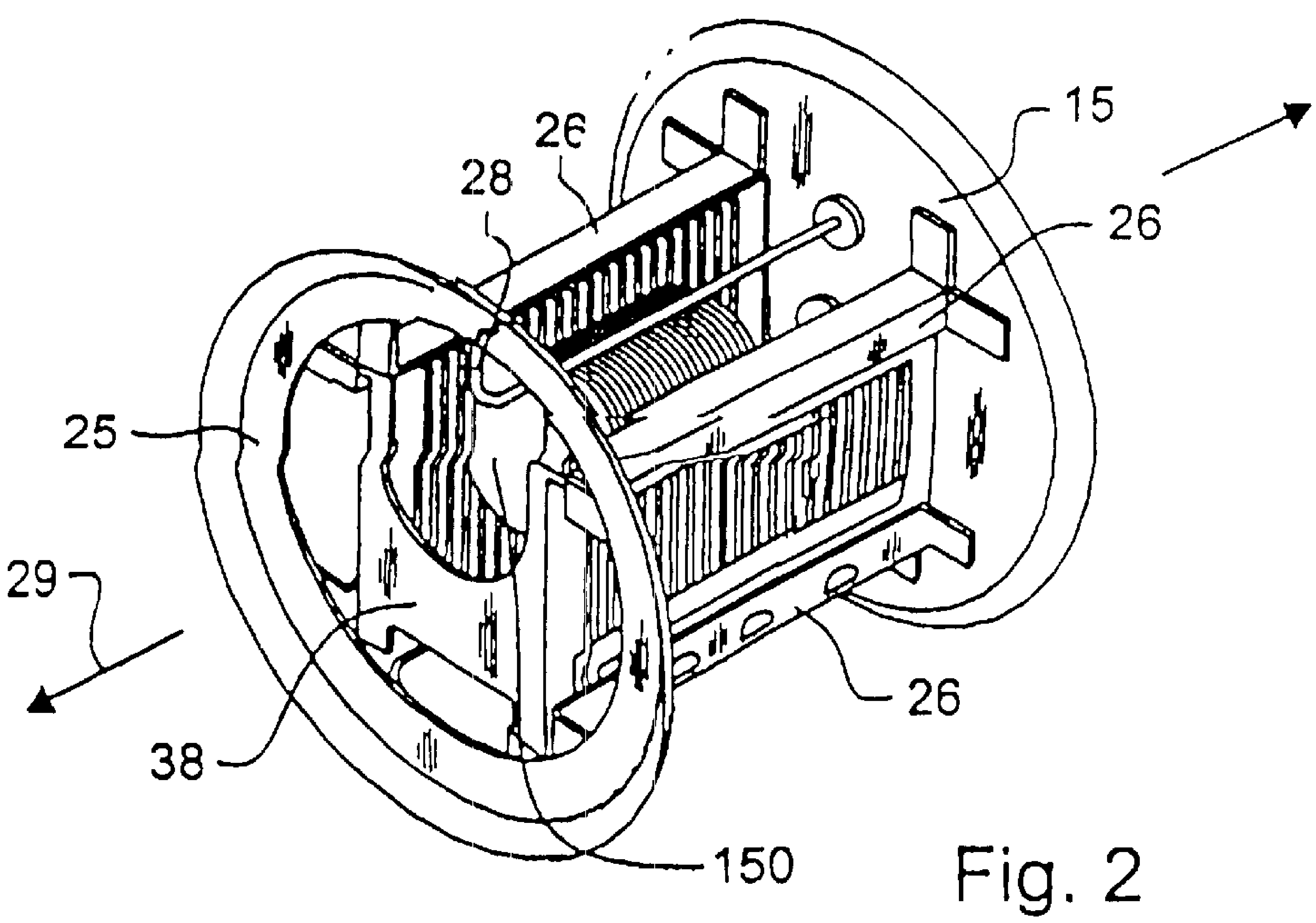
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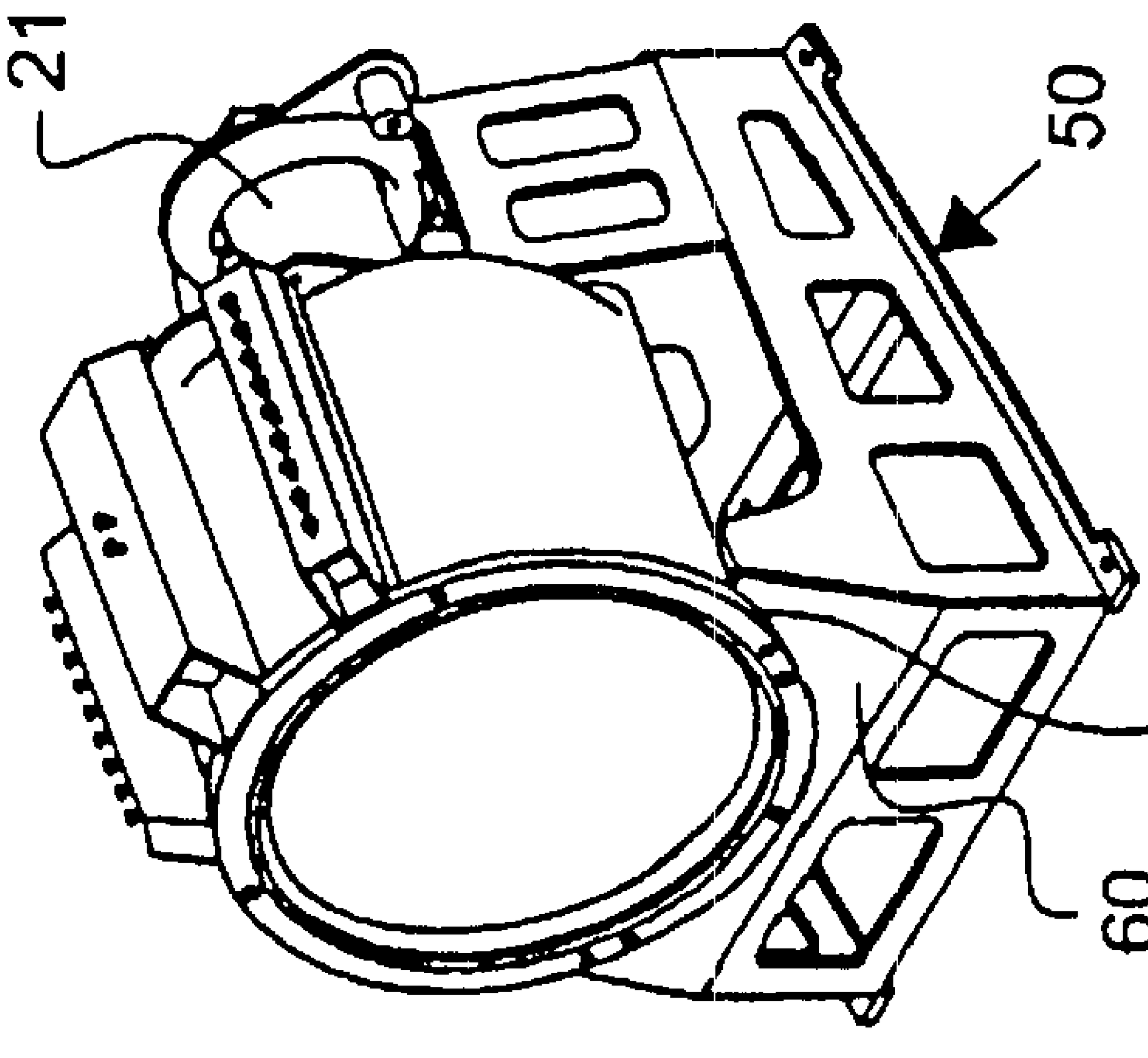
Fig. 2


21
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65
60

Fig. 3

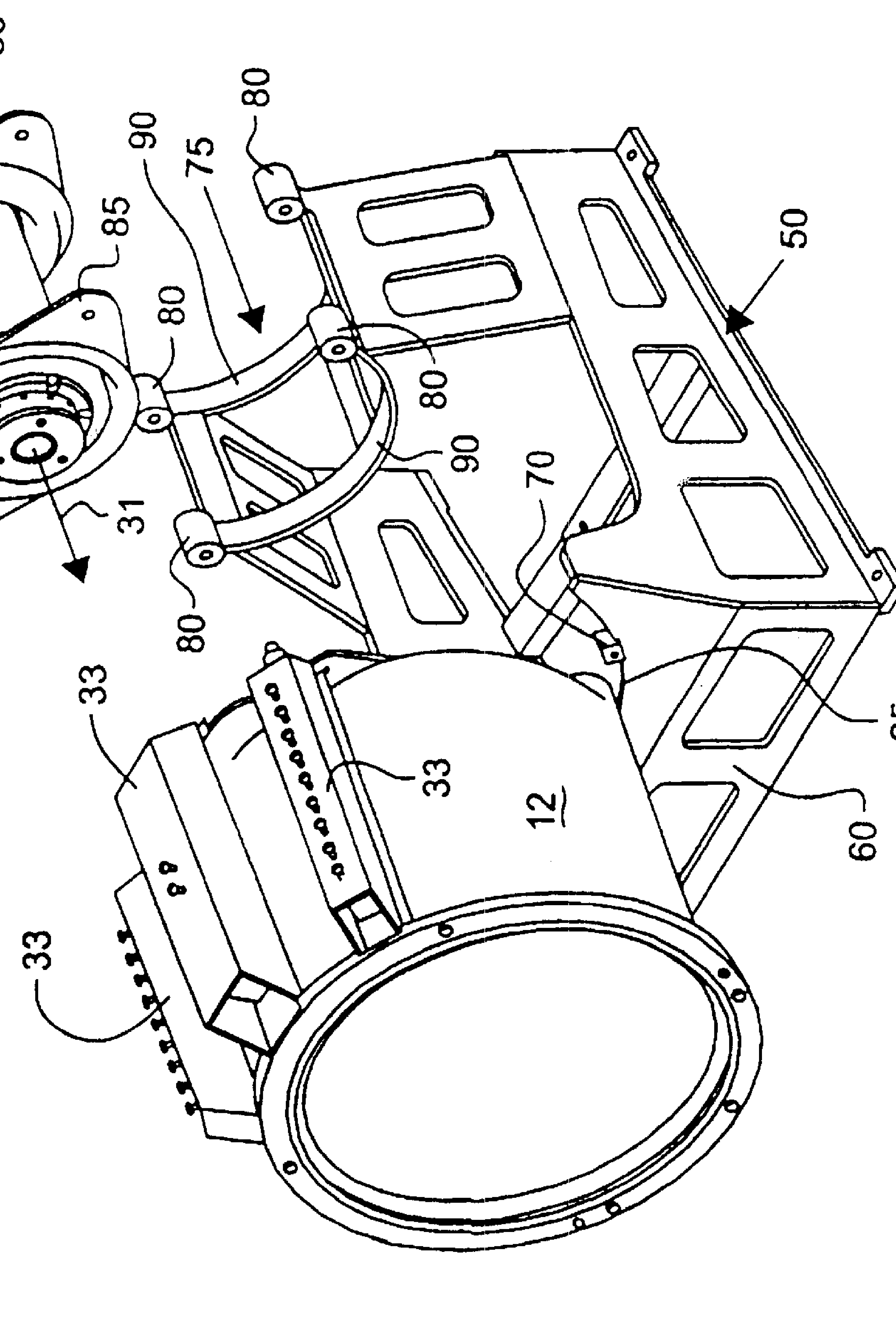
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Fig. 4

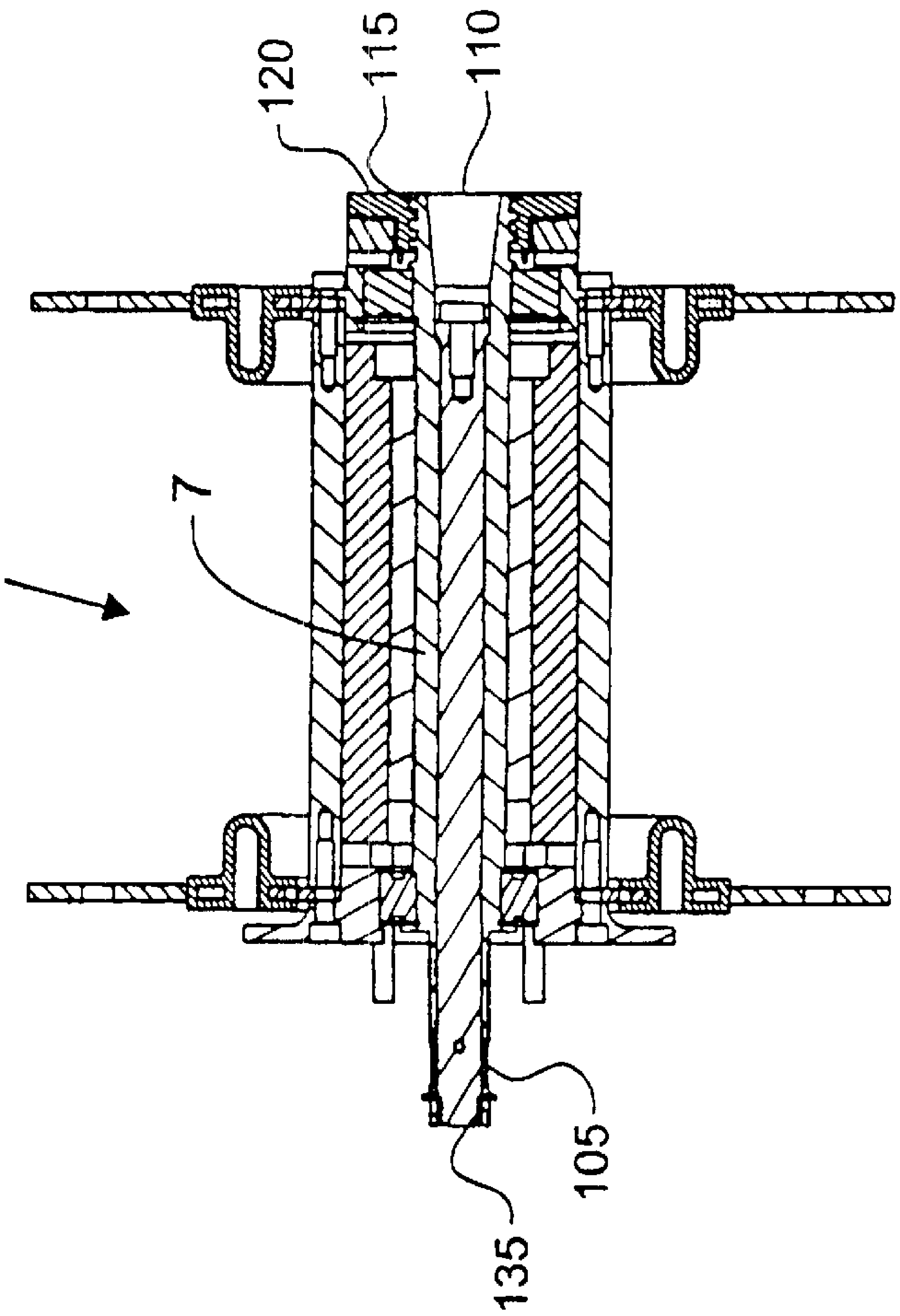


Fig. 6

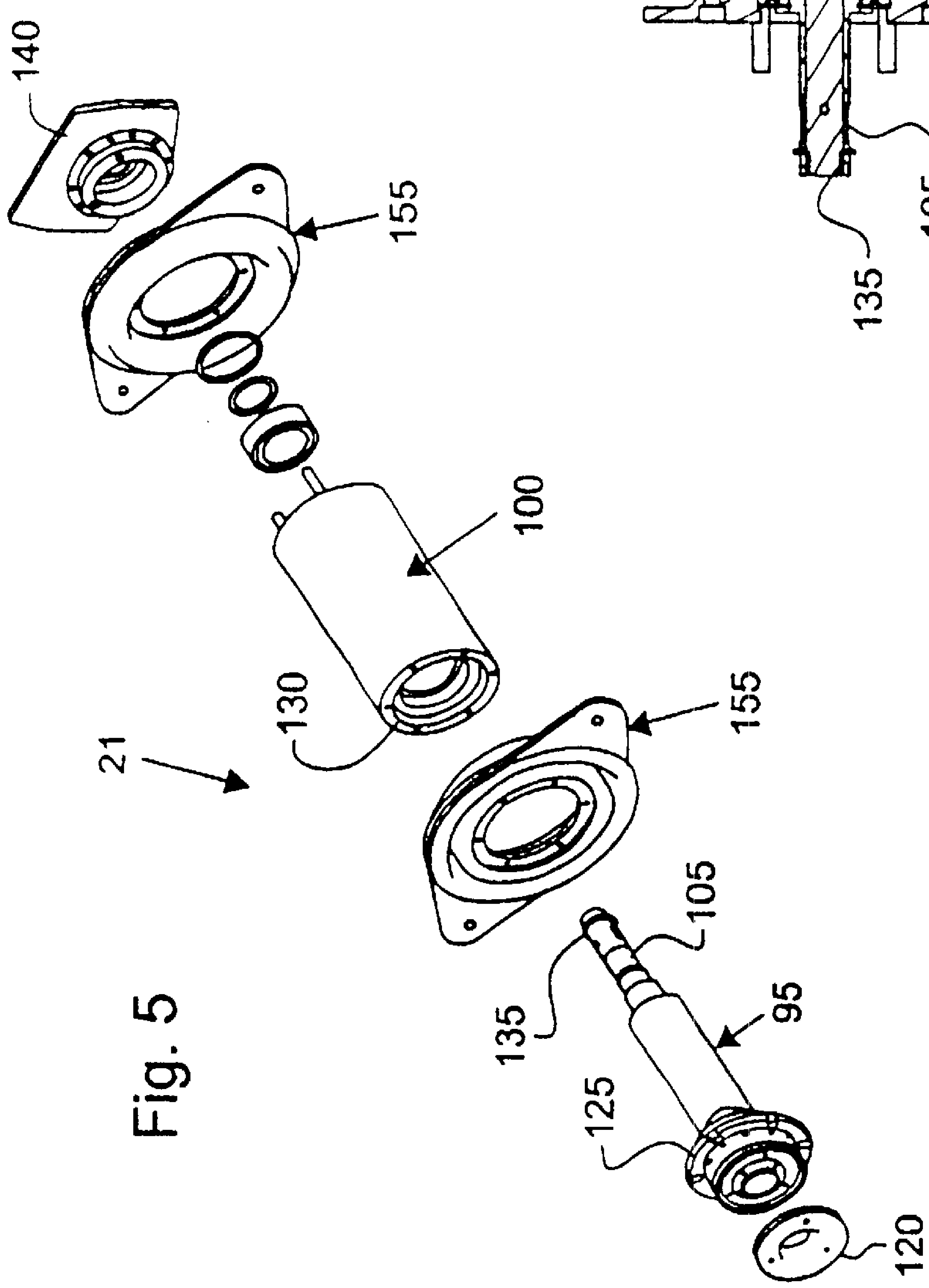


Fig. 5

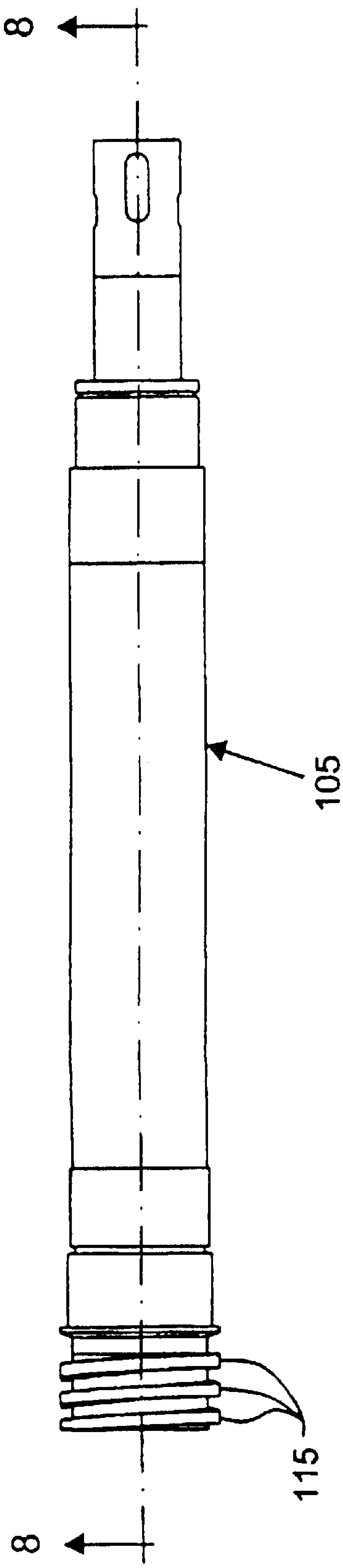


Fig. 7

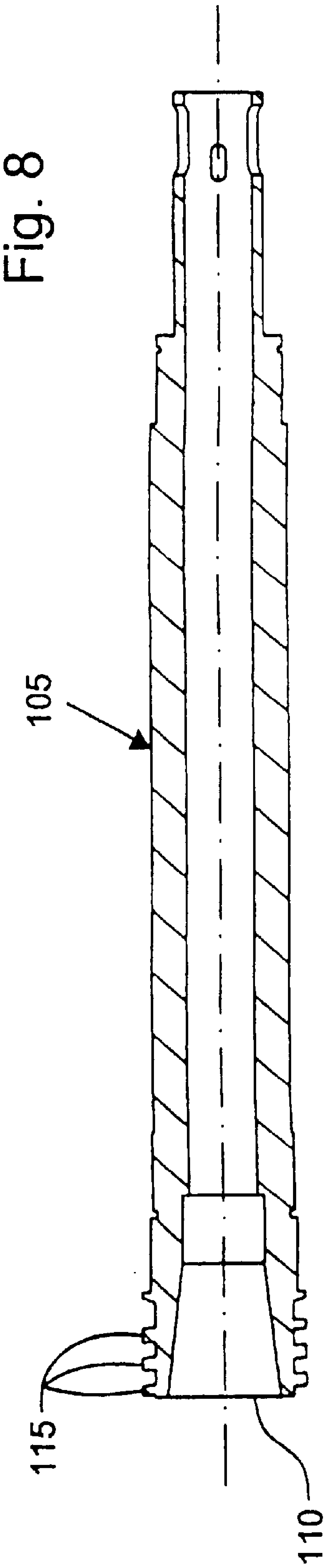


Fig. 8

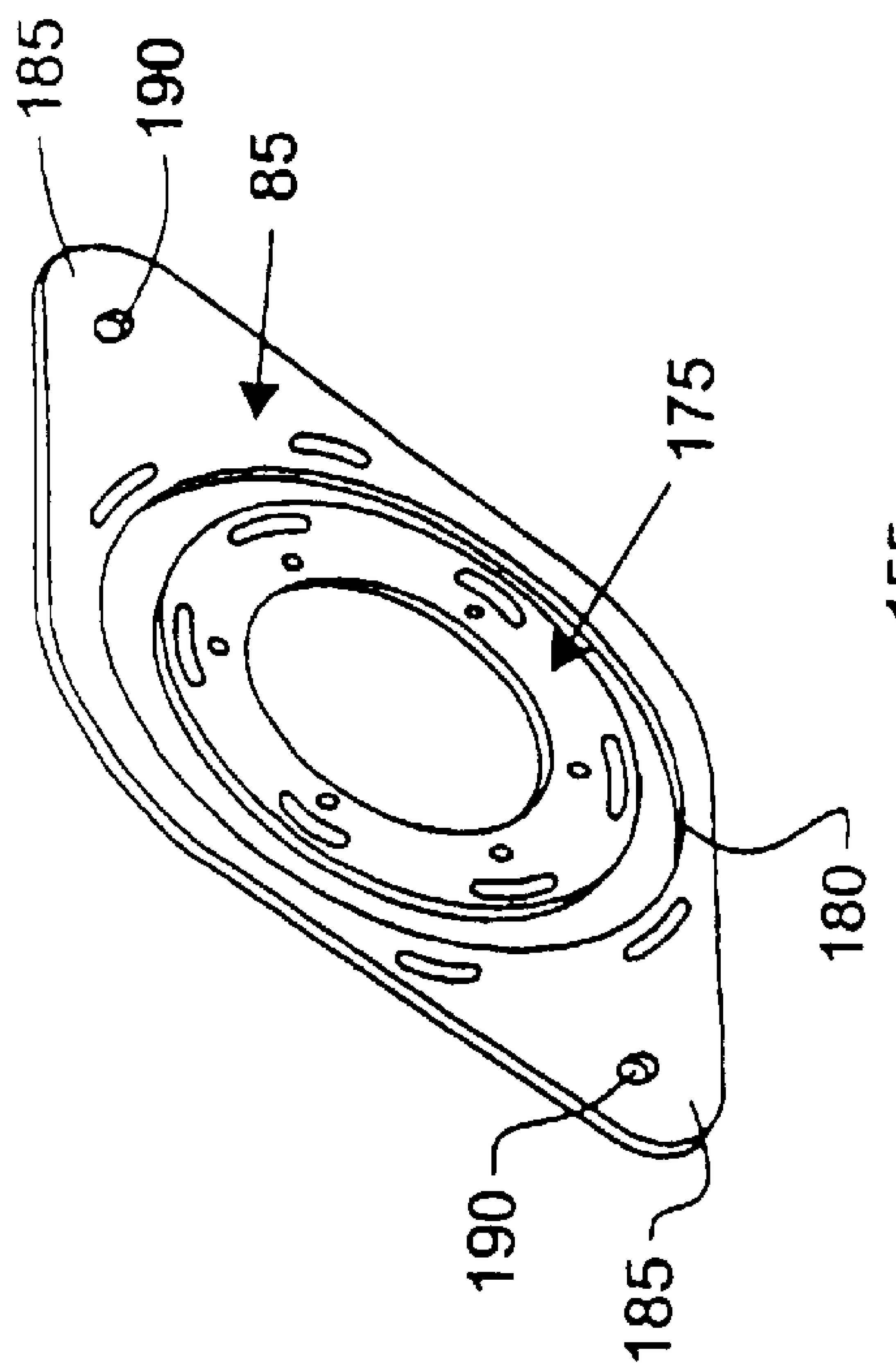


Fig. 9

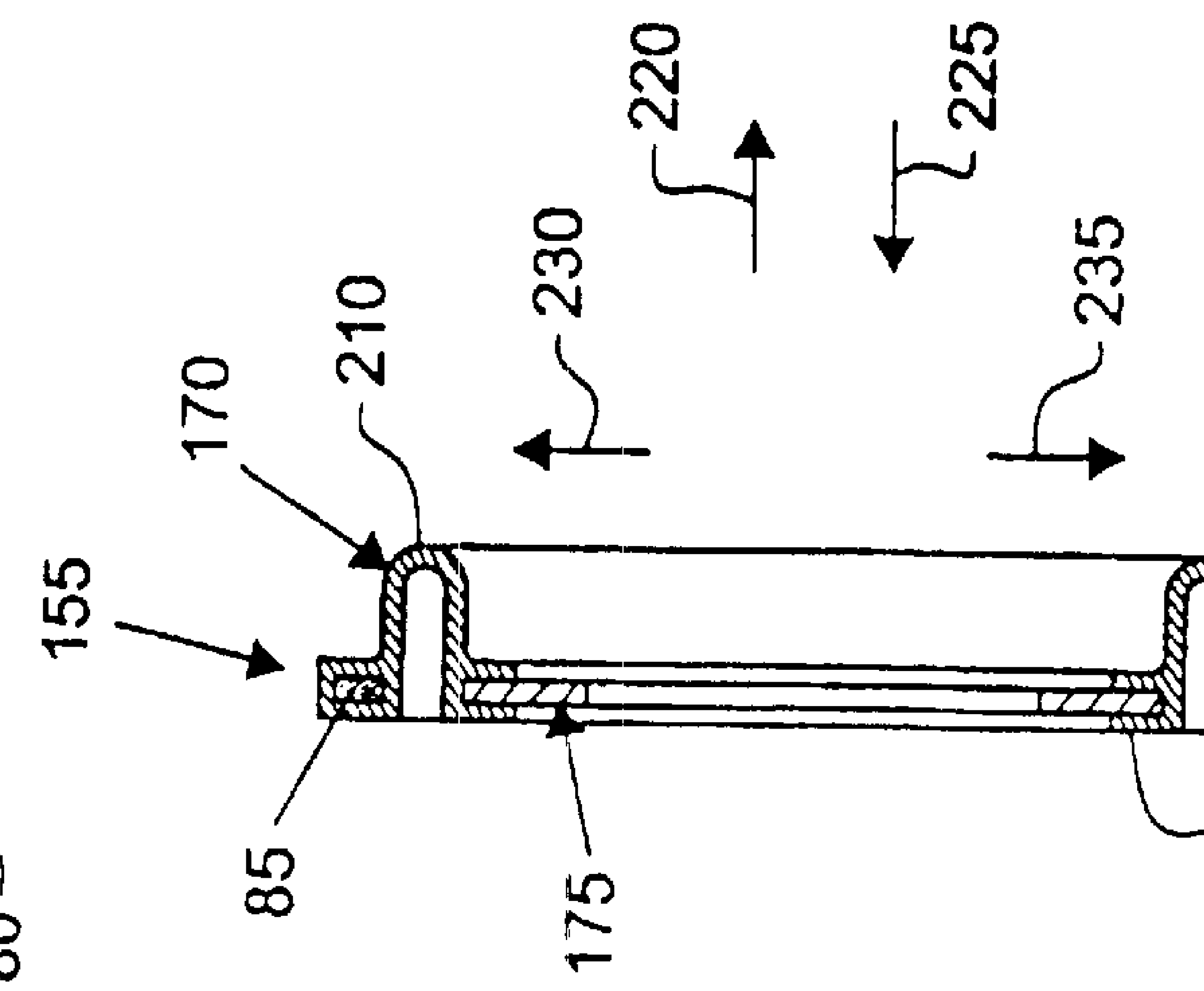


Fig. 11

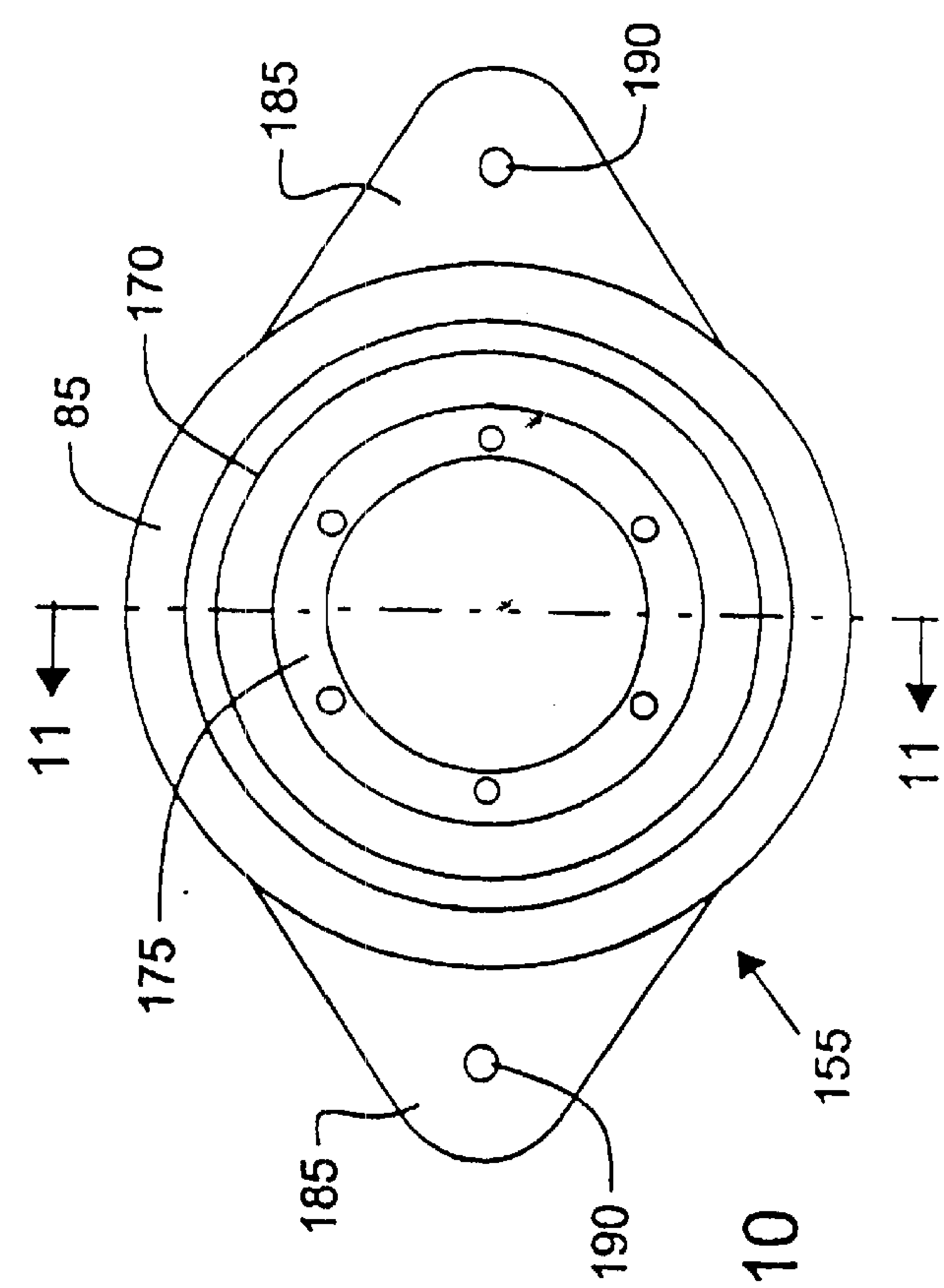


Fig. 10

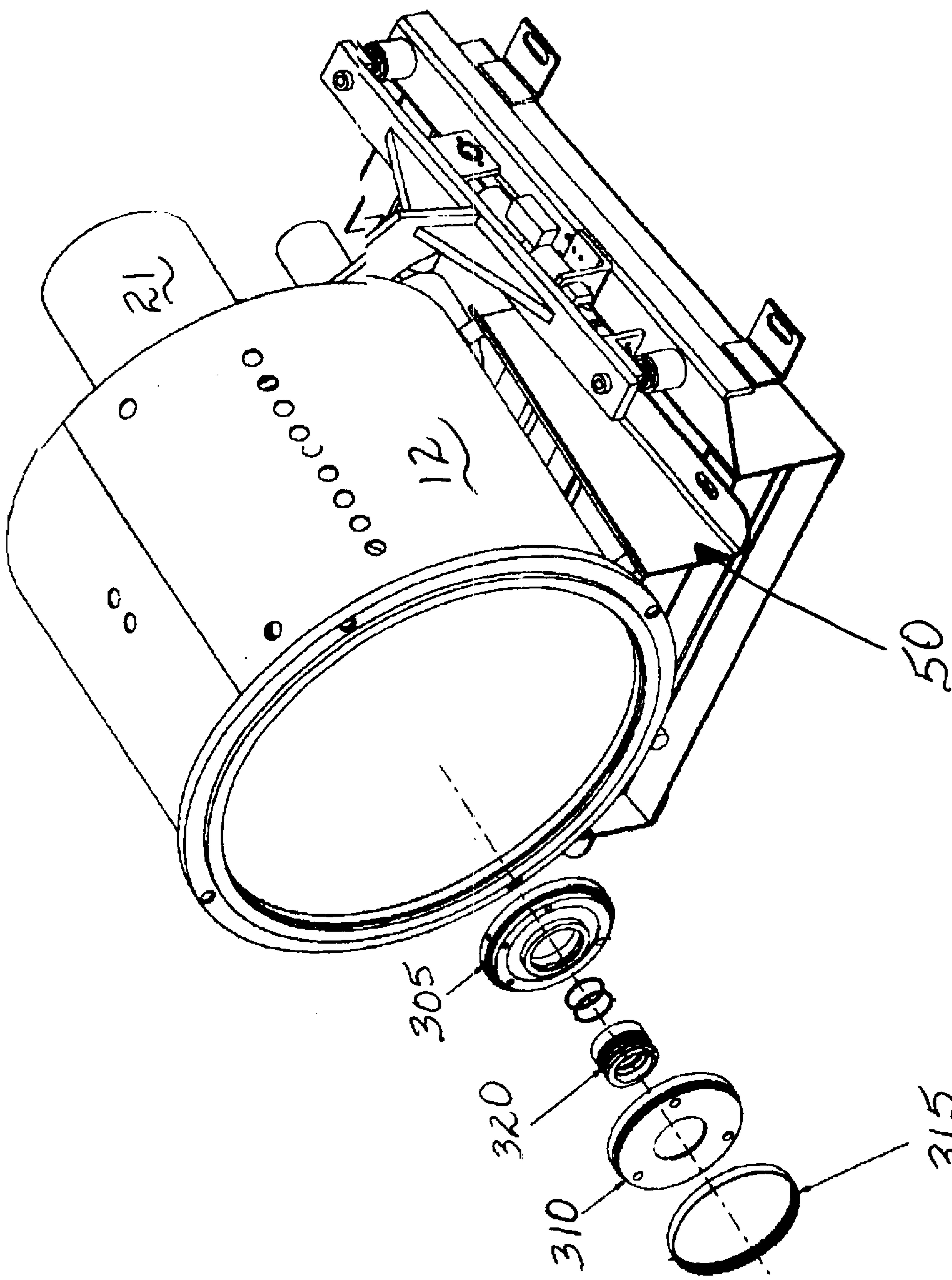
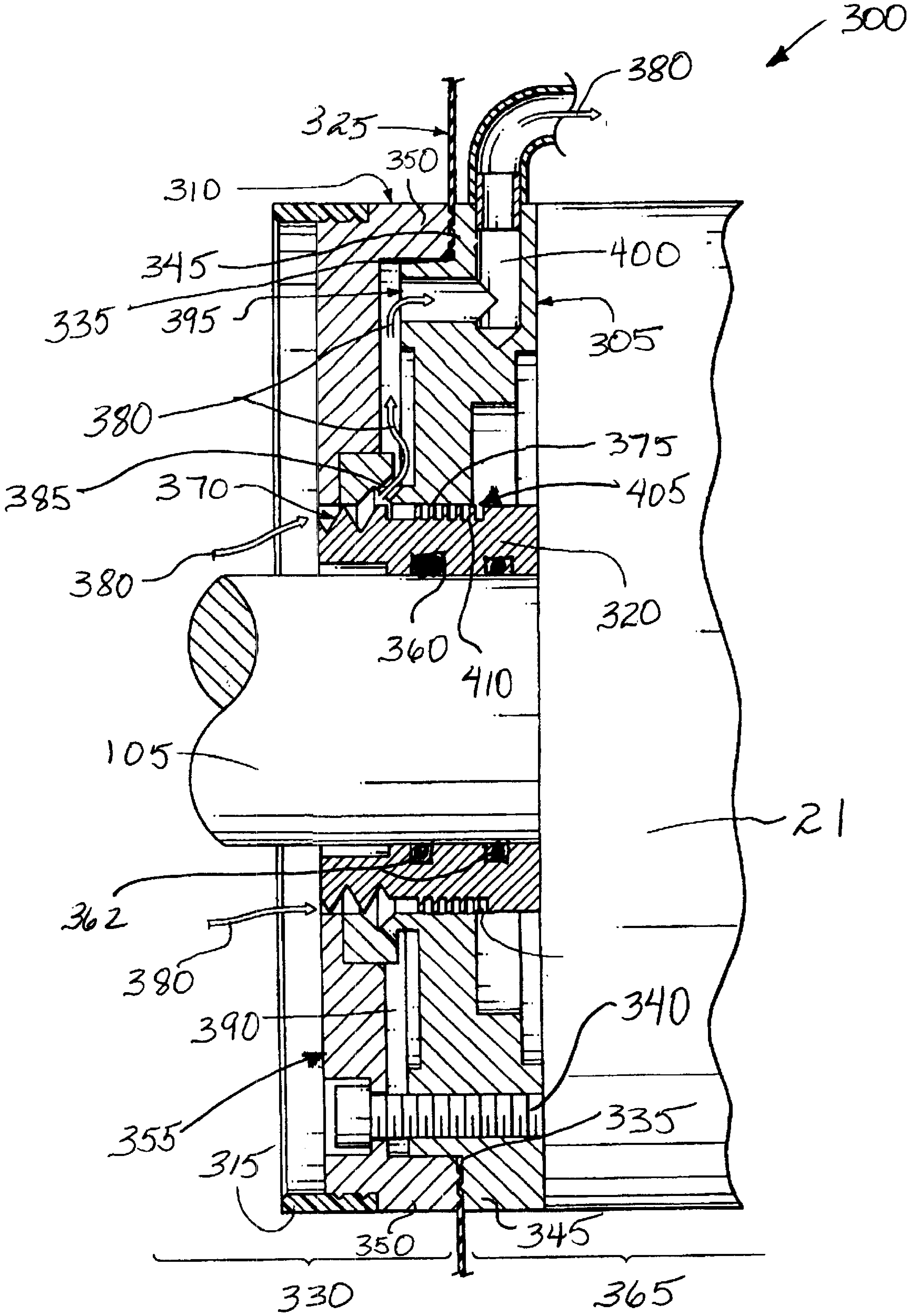


FIGURE 12

FIGURE 13



300
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SEAL CONFIGURATION FOR USE WITH A MOTOR DRIVE ASSEMBLY IN A MICROELECTRONIC WORKPIECE PROCESSING SYSTEM

CROSS-REFERENCE TO RELATED APPLICATIONS

None

BACKGROUND OF THE INVENTION

This invention relates to an apparatus for processing microelectronic workpieces, such as semiconductor workpieces, glass photomask plates, memory media workpieces, workpieces used in the formation of micro-mechanical devices and/or components, etc. More particularly, the invention is directed to a seal arrangement for use in a microelectronic workpiece processing system that assists in improving the workpiece processing yield.

In the production of integrated circuits and other micro-electronic components, etc., the microelectronic workpieces undergo multiple processing steps. The basic material for the workpiece substrates may be silicon, glass, ceramic materials of various sorts or other similar materials of very thin waferlike configuration. This basic substrate is subjected to coating, etching, and cleaning processes and it is extremely important that each processing step is performed with the greatest possible yield thereby lowering production costs.

Microelectronic workpieces have been processed by spinning them about a vertical axis where the wafers or masks are stacked vertically as described in U.S. Pat. No. 3,760,822 with various holding mechanisms such as vacuum chucks. This has led to further disadvantages where the workpiece may be only processed on one side at a time without a significantly different processing rate, wherein the topside processes at a much faster rate than that of the underside.

Other processing devices such as described in U.S. Pat. No. 3,970,471, process each wafer individually. Although the wafer is rotated about a horizontal axis, such a device can only process a single wafer at each station which may be expensive and time consuming.

To eliminate many of the problems noted above, the assignee of the present invention developed a wafer processing system and set forth and claimed the system in U.S. Pat. No. 4,300,581, titled "Centrifugal Wafer Processor", issued Nov. 17, 1981. The invention set forth therein permits the processing of a plurality of wafers at the same time in a carrier. In accordance with that invention, microelectronic workpieces are processed by inserting them into the carrier and placing the carrier in a rotor, which rotates around a substantially horizontal axis (although disposed at a slight angle). Various processing fluids may be applied to the workpieces uniformly through the spray nozzles while the workpieces are being rotated.

The foregoing system includes built-in shock absorbers that extend vertically from a frame that supports a bowl into which the carrier is inserted. The shock absorbers assist in reducing the transfer of vibrational energy to the carrier. The reduction of vibration energy transfer facilitates a greater processing yield since the workpieces are not subject to damaging mechanical stresses and strains. The present inventors have recognized a further manner in which to reduce the vibration energy transfer using a direct drive motor assembly having one or more shock absorbing structures associated therewith. A still further problem present in the prior apparatus is the sealing of the motor to isolate it from exposure to materials, such as processing fluids. The present inventors have provided a unique solution to this problem by providing a seal about the rotor of the motor.

BRIEF SUMMARY OF THE INVENTION

An apparatus for processing a microelectronic workpiece, such as a semiconductor wafer, is set forth. The apparatus comprises a processing bowl that defines a processing chamber. A seal is provided to assist in removing fluids, such as processing fluids, from the processing chamber that are in the proximity of the seal. Further, the seal is provided to assist in preventing the fluids from entering the motor. To this end, flow generating threads and expulsion threads are provided at an end of a shaft assembly that is connected to be driven by the motor. A member substantially surrounds at least a portion of the flow generating threads and at least a portion of the expulsion threads. Together, the member defines a chamber with the shaft assembly. Rotation of the shaft assembly results in corresponding rotation of the flow generating threads and expulsion threads to drive fluids proximate the shaft assembly to an exhaust while concurrently assisting in preventing such fluids from entering the motor.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

FIG. **1** is a perspective view of one embodiment of a microelectronic workpiece processing apparatus that may employ the motor mount and seal of the present invention.

FIG. **2** is a wafer carrier shaft assembly for use in the apparatus of FIG. **1** .

FIG. **3** is a perspective view of one embodiment of a bowl, motor assembly, and frame used in the apparatus of FIG. **1**.

FIG. **4** is an exploded view of the components of FIG. **3**.

FIG. **5** is an exploded view of a motor assembly constructed in accordance with one embodiment of the present invention.

FIG. **6** is a side, cross-sectional view of a motor assembly constructed using the components of FIG. **5**.

FIGS. **7** and **8** illustrate one embodiment of a rotor shaft suitable for use in the motor assembly of FIG. **6**.

FIGS. **9–11** are various views of the shock absorbing assembly used in the embodiment of the motor assembly shown in FIGS. **5** and **6**.

FIG. **12** is a perspective view of the components of a seal in accordance with one embodiment of the present invention.

FIG. **13** is a cross-sectional view of the components of FIG. **12** as they are assembled with one another.

DETAILED DESCRIPTION OF THE INVENTION

Referring now to the drawings, an exemplary apparatus **10** for processing workpieces, such as semiconductor wafers, is illustrated in FIG. **1**. This apparatus is merely one type of microelectronic workpiece processing apparatus in which the direct motor drive of the present invention may be used. Another similar processing apparatus that may employ the direct motor drive of the present invention is set forth in U.S. Pat. No. 5,022,419, titled "Rinser Dryer System", issued Jun. 11, 1991, and assigned to the assignee of the present invention. The teachings of both the '581 and '419 patent are incorporated by reference.

The exemplary apparatus **10**, as shown in FIG. **1**. has a somewhat a rectangular outer configuration and a front opening. This style of apparatus is sometimes referred to as a front-loading processor, indicative of the manner in which semiconductor wafers are placed into the apparatus. The apparatus **10** includes a frame and cabinet assembly, shown generally at **11**, which houses a stationary bowl **12** with a front opening **13**. A hinged door **14** on the frame is arranged to seal with respect to the opening **13** so that the bowl and door provide an enclosed processing chamber. Bowl **12** is preferably constructed of corrosion and solvent resistant material such as stainless steel, and is cylindrically shaped with a drain at the bottom for removal of processing fluids during the processing cycles.

A carrier rotor **15** is concentrically arranged within bowl **12**. The carrier rotor includes support members **26**, support rod **28**, and support ring **25**. Carrier rotor **15** is supported within bowl **12** for rotation about a rotation axis **29** in a known manner.

FIG. **3** shows the principal operational components of the upper section **30** of the apparatus **10** with various cabinet panels remove. In the illustrated embodiment, the carrier rotor **15** (not shown in FIG. **3**) is either directly or indirectly coupled to an electrically driven motor assembly **21** that has a rotor shaft having an axis of rotation **31** (see FIG. **4**) coinciding with the axis of rotation **29** of carrier rotor **15** (see FIG. **1**) when the apparatus is assembled. The motor assembly **21** provides a controlled rotational driving of carrier rotor **15** within bowl **12**.

As illustrated in FIGS. **3** and **4**, bowl **12** is stationary and is connected to frame **50**. In some systems, the frame **50** may be vibrationally supported by shock absorbers **17** (FIG. **1**) within cabinet **55**. The bowl **12** is provided with a plurality of spray members **33** that are disposed above and parallel to support members **26** of carrier rotor **15** to direct processing fluids toward wafers supported in the processing chamber by the carrier **38**. Support member **26** and support rod **28** are coupled to support ring **25** as shown in FIG. **2**, providing the outer support for carrier **38**.

Referring again to FIGS. **3** and **4**, frame **50** includes a front end **60** having a cutout **65** with attaching lugs **70** for securement with the bowl **12**. The frame **50** further includes a motor support sub-frame **75** that is shaped to accept the electrically driven motor assembly **21**. The motor support sub-frame **75** includes lugs **80** that provide means for securement with outer flange members **85** of the motor assembly **21** and concave cutout sections **90** that allow portions of the motor assembly **21** to fit within frame **50**.

FIG. **5** illustrates an exploded view of various individual components of the motor assembly **21** while FIG. **6** illustrates a cross-sectional view of the assembled motor assembly **21**. As illustrated, the motor assembly **21** comprises a motor shaft assembly **95** and a motor stator assembly **100**. The motor shaft assembly **95** includes a central rotor shaft **105** having a proximal end **110** for either direct or indirect connection with the carrier rotor **15**. Expulsion threads **115** are provided at an exterior surface of the rotor shaft **105** at the proximal end **110**. A retaining member **120** made, for example, from stainless steel, is disposed over the proximal end of shaft **105** and seals with the otherwise exposed end portion of shaft assembly **95**. The member **120** forms a close fit to the outside diameter of expulsion threads **115**. Preferably, no direct contact is made between the expulsion threads **115** and member **120**. The inner surface of member **120** forms a chamber with the proximal end of shaft **105**. During operation, the rotational movement of shaft **105** and expulsion threads **115** urges any processing liquids proximate shaft **105** away from the motor assembly and back into the bowl **12**.

Further details concerning the particular embodiment of the central rotating shaft **105** used here are apparent from the views thereof in FIGS. **7** and **8**. As illustrated, expulsion threads **115** in the form of a plurality of helical threads. Other threaded configurations may likewise be used. For example, the expulsion threads **115** may be in the form of a plurality of parallel or angled grooves.

The motor shaft assembly **95** is disposed in a central opening of stator assembly **100** and has a flange **125** at its proximal end that engages and is secured to a mounting face **130** of the stator assembly **100**. The distal end **135** of the motor shaft assembly **95** extends beyond the distal. end of the stator assembly **100** to engage an end plate **140**.

During operation of the apparatus **10**, vibrational energy is generated. The vibrational energy may be generated external to apparatus **10** and transferred to carrier **15** and wafers **150** and, further, may be generated internally due, for example, to imbalance in the rotating members in the bowl **12**. This vibrational energy may damage the wafers **150** in the carrier rotor **15** if precautions are not made to limit the transfer of this energy to the wafers **150**. To this end, the motor assembly **21** is provided with shock absorbing members **155** disposed at both the proximal and distal ends of the motor assembly **21**. These shock absorbing members **155**, as best illustrated in FIGS. **3** and **4**, are used to mount the motor assembly **21** to the frame **50** of the processing apparatus **10** thereby assisting in preventing the motor assembly **21** from transferring vibrational energy to the carrier rotor **15** and wafers **150** and, further, allowing receipt of vibrational energy from the frame **50**. Such isolation limits the amount of vibrational energy that is ultimately absorbed by the carrier rotor **15** and wafers **150**.

As illustrated in FIGS. **9–11**, the shock absorbing members **155** are comprised of three parts: the outer flange member **85**, a shock absorbing web **170**, and a motor mount member **175**. The outer flange member **85** includes a central aperture **180** and oppositely extending mounting ears **185**. Each mounting ear **185** includes an aperture **190** for accepting a securement for securing the flange member **85** to the frame **50**. The motor mount member **175** of the illustrated embodiment is generally circular in shape and has a plurality of apertures disposed about the circumference thereof to accept securements therethrough for securing the motor mount member **175** to the face of stator housing **100** and flange **125** of the shaft assembly **95**. The motor mount member **175** has an outside diameter that is a predetermined degree smaller than the inside diameter of the central aperture **180** of the outer flange member **85**. The difference in diameters allows the outer flange member **85** and the motor mount member **175** to be mounted concentric with one another with the shock absorbing web **170** extending about and, preferably, consuming the interstitial regions between them. In the illustrated embodiment, the shock absorbing member **155** is ultimately mounted about the stator housing **130** and shaft assembly **95** so that the centers of the apertures of both the outer flange member **85** and motor mount **175** are coincident with the axis of rotation **31** of the rotor shaft **105**. It will be recognized that such shapes and the concentricity discussed here merely exemplify one embodiment of the motor assembly.

With particular reference to FIG. **11**, it can be seen that the shock absorbing web **170** includes an outer peripheral lip **200** that engages and secures with the outer flange member

85 and an interior lip 205 that engages and secures with the motor mount member 175. An intermediate arched section 210 extends circumferentially about the shock absorbing web 170 in the region between the outer peripheral lip 200 and the interior lip 205. The shock absorbing web 170 is preferably made from a resilient material, such as urethane, that can absorb energy through deformation when subjected to vibrational forces and yet consistently return to its normal shape upon removal of the forces. The particular configuration illustrated here can elastically deform to some degree in directions such as 220 and 225 that are generally parallel to the axis of rotation 31 of the rotor shaft 105. However, significant elastic deformation occurs along directions, as at 230 and 235, that are generally perpendicular to the axis of rotation 31. As such, the shock absorbing web 170 effectively isolates the outer flange member 85 and frame 50 from the motor mount member 175, stator assembly 100, and shaft assembly 95 by elastically deforming in response to vibrational forces along and perpendicular to the axis of rotation 31. Such isolation reduces the amount of potentially damaging mechanical energy that ultimately reaches the wafers 150. Wafer processing yields are thus increased, thereby making use of the present invention very economical and beneficial.

In operation of the apparatus 10, semiconductor wafers in carrier 38 are placed in support members 26 of carrier rotor 15 as shown in FIG. 2. Support rod 28, as shown in FIG. 2, retains the semiconductor wafers in carrier 38 when carrier rotor 15 is revolving at relatively low RPM's. As the speed of rotation of carrier rotor 15 increases, the semiconductor wafers 150 are held in place by centrifugal force. The semiconductor wafers 150 are processed by the application of various fluids through spray members 33. Carrier rotor 15 rotates substantially around rotation axis 29. The axis of rotation of carrier rotor 15 coincides with the axis of rotation of rotor shaft 105 of the motor assembly 21. It is desirable that this angle of the axis of rotation be greater or lesser than exactly horizontal to prevent the semiconductor wafers from contacting each other during processing. If the semiconductor wafers or masks contact each other during processing, a surface tension may be formed which would prevent processing of the semiconductor wafers or masks in the area of contact resulting in a lower yield. In the preferred embodiment shown here, the angle of the axis of rotation is more or less 10 degrees above horizontal. This adds to the ease of loading of the semiconductor wafers and, as a result of the angle, carrier 38 easily slides into support members 26 without the requirement of a retaining device to prohibit carrier 38 from falling out of apparatus 10.

The high rate rotation of the semiconductor wafers by carrier rotor 15 allows the pressure of the processing fluids applied by spray members 33 to be low and therefore saving extensive costs in the elimination of high pressure equipment. Spray members 33 in the preferred embodiment separately carry the processing fluids and, further, the heated nitrogen used during drying to permit safe optimum performance.

During operation, the semiconductor wafer may be observed through optional window 18 of door 14. Apparatus 10 will not operate until door 14 is closed and locked with locking switch 42. Although not particularly pertinent to the present invention, alternative door assemblies may be used.

Various user interfaces are used to facilitate user control of parameters such as timing of various processing and rinsing steps, temperatures at which such processing steps are to take place, speeds at which the semiconductor wafers are rotated, etc. Such controls, however, are likewise not particularly pertinent to the present invention.

FIGS. 12 and 13 illustrate a further embodiment of a seal arrangement, shown generally at 300, that may be used to assist with escape of fluids, such as processing liquids and/or gases, from the proximity of the seal while concurrently protecting the motor and other components from the processing environment. As will be evident from the description below, this seal arrangement may also be used to prevent the escape of processing liquids and/or gases from the processing chamber.

Without limitation, this particular embodiment is shown as being implemented without the corresponding web shock absorbing components. Further, it is purposely shown as, but not limited to, an exemplary retrofit for use in, for example, an existing batch processor, such as an SAT® or SST® available from Semitool, Inc., of Kalispell, Mont.

Generally stated, the improved seal is comprised of four components (although not all components are necessarily required): motor adapter 305, seal retainer cap 310, ring seal 315, and seal member 320. As shown, motor adapter 305 is disposed at the exterior of a back wall boot 325 that separates the process chamber environment, shown generally at 330, from the ambient environment proximate motor 21. In the illustrated embodiment, motor adapter 305 extends through a corresponding aperture 335 disposed through the back wall boot 325 and engages seal retainer cap 310, which is disposed on the process chamber side 330 of the back wall boot 325. Seal retainer cap 310 and motor adapter 305 are secured to one another by, for example, one or more fasteners 340, etc. When secured with one another, flange 345 of motor adapter 305 and flange 350 of seal retainer cap 310 cooperate to grip the back wall boot 325 therebetween. This cooperation forms a retainer cap/motor adapter assembly, shown generally at 355, that assists in isolating the process chamber environment from the atmosphere environment along the periphery of the aperture 335.

Seal member 320 is disposed for co-rotation with motor shaft 105. In the particular embodiment illustrated here, motor shaft 105 extends through and seals with the interior walls of a central bore 360 with the assistance of one or more O-ring seals. In turn, motor shaft 105 and seal member 320 extend through a centrally disposed aperture formed in the cap/motor adapter assembly 355.

With particular reference to FIG. 13, the exterior surface of the seal member 320 is provided with a plurality of structures that assist in guiding fluids along a desired path. In the illustrated embodiment, the plurality of structures are used to effectively vent processing fluids from the process chamber side 330 of the back wall boot 325 and toward the atmospheric side 365 thereof. Although subject to modification, the particular structures used to generate this fluid flow include a plurality of flow generating threads disposed proximate the process chamber. In the illustrated embodiment, the flow generating threads are in the form of helical threads 370 that are dimensioned so that the outer periphery thereof closely conforms to the inner walls of central aperture 375 of the retainer cap/motor adapter assembly 355. It will be recognized that the helical threads may be formed alternatively as an integral structure with the shaft 105.

In operation, seal member 320 rotates along with motor shaft 105. This also causes rotation of the helical threads 370, which generate a flow of fluids, such as gases, along a fluid flow path designated by arrows 380. The illustrated fluid flow path directs the fluid flow to an exhaust or the like.

In the illustrated embodiment, it is the motor adapter 305 and seal retainer cap 310 that cooperate to define one or more fluid flow chambers that constrain the fluid flow path. More particularly, fluid driven by the rotation of the helical threads **370** is directed through one or more inlet vents **385** disposed in the motor adapter **305**. The inlet vent **385** opens to an annular chamber **390** having side walls that are respectively defined by the seal retainer cap **310** and motor adapter **305**. Annular chamber **390** opens to a vent passage **395** and exhaust port **400** that are disposed in fluid communication with one another in the motor adapter **305**. Exhaust port **400**, depending on the processing fluid employed in the process chamber, can be connected to provide the exhausted fluids to the ambient environment, a chemical containment area for subsequent disposal, or a chemical containment area for subsequent replenishment and/or recirculation.

A number of structural features at the periphery of the seal member **320** assist in ensuring that the fluid conducted by the helical threads **375** enters the inlet vent **395**. For example, inlet vent **395** may be disposed to accept the fluid at an angle that corresponds with the angle of the last of the helical threads **375***a*. Further, fluid flow beyond the last of the helical threads **375***a* is inhibited by a sealing arrangement, shown generally at **405**. In the illustrated embodiment, the sealing arrangement **405** is comprised of a plurality of parallel grooves **410**, the outermost portions of which are in close conformity with the sidewalls of aperture **410**. The sealing arrangement **405** may also be in the form of expulsion threads, such as expulsion threads **115** illustrated in FIGS. **6–8** and discussed in detail above.

Also illustrated in each of FIGS. **12** and **13** is a ring seal **315**. Ring seal **315** snaps into place upon the seal retainer cap **310** and rides within a groove of carrier support **15** that, in turn, is attached to the components responsible for supporting the plurality of wafers. The wafer support components, in turn, are rotated by shaft **105**. Ring seal **315** thus assists in isolating the process chamber environment from any contaminants proximate to or otherwise generated by the rotation of motor shaft **105**, the rotation of sealing member **320**, and/or contaminants at the interior of the motor **21**. Preferably, contaminants generated at the interior of motor **21** that escape past sealing arrangement **410**, if any, will be purged through exhaust port **400** along with the vented fluids.

Numerous modifications may be made to the foregoing system without departing from the basic teachings thereof. Although the present invention has been described in substantial detail with reference to one or more specific embodiments, those of skill in the art will recognize that changes may be made thereto without departing from the scope and spirit of the invention as set forth in the appended claims.

What is claimed is:

1. An apparatus for use in processing a microelectronic workpiece, the apparatus comprising:

a processing bowl defining a processing chamber;

a motor drive assembly connected to drive one or more components disposed in the processing chamber, the motor drive assembly comprising

a motor,

a shaft assembly connected to be driven by the motor about an axis of rotation, the shaft assembly having expulsion threads at an end thereof that is proximate the processing chamber; and

a chamber forming member substantially surrounding the expulsion threads at the end of the shaft assembly proximate the processing chamber to form an expulsion chamber about at least a portion of the expulsion threads,

rotation of the expulsion threads as the shaft assembly is driven by the motor thereby assisting in preventing foreign materials from entering the motor along the shaft assembly.

2. An apparatus as claimed in claim **1** wherein the expulsion threads are in the form of a plurality of helical threads.

3. An apparatus as claimed in claim **1** wherein the expulsion threads are in the form of a plurality of parallel grooves.

4. An apparatus as claimed in claim **1** wherein the shaft assembly is connected to drive a wafer support assembly disposed in the processing chamber.

5. An apparatus as claimed in claim **4** wherein the workpiece support assembly is adapted to support a plurality of microelectronic workpieces for batch processing in the processing chamber.

6. An apparatus for use in processing a microelectronic workpiece, the apparatus comprising:

a processing bowl defining a processing chamber;

a motor drive assembly connected to drive one or more components disposed in the processing chamber, the motor drive assembly comprising

a motor;

a shaft assembly that is connected to be rotated by the motor about an axis of rotation, the shaft assembly having flow generating threads at an end thereof that is proximate the processing chamber; and

a chamber forming member substantially surrounding the flow generating threads at the end of the shaft assembly proximate the processing chamber to thereby form a flow chamber about at least a portion of the flow generating threads,

rotation of the flow generating threads as the shaft assembly is driven by the motor urging a flow of fluid from the processing chamber toward an exhaust.

7. An apparatus as claimed in claim **6** wherein the shaft assembly comprises:

a drive shaft connected to the motor; and

a seal member disposed about a peripheral portion of the drive shaft and connected for co-rotation with the drive shaft, the seal member including

a peripheral surface that includes the flow generating threads.

8. An apparatus as claimed in claim **6** wherein the flow generating threads are in the form of helical threads disposed at the end of the shaft assembly.

9. An apparatus as claimed in **6** wherein the chamber forming member comprises one or more fluid channels disposed to receive the flow of fluid provided by the flow generating threads.

10. An apparatus as claimed in **9** wherein the flow generating threads are in the form of helical threads and wherein the one or more fluid channels comprise an inlet vent disposed to receive the flow of fluid deflected from at least an angled surface of one of the helical threads proximate the inlet vent, the inlet vent being defined by one or more surfaces angled in general alignment with the angled surface of the one of the helical threads.

11. An apparatus as claimed in **9** wherein the one or more fluid channels comprise:

an inlet vent disposed to receive the flow of fluid from the flow generating threads;

an annular chamber in fluid communication with the inlet vent and disposed generally concentric with an axis of rotation of the shaft assembly; and an exhaust port in fluid communication with the annular chamber.

12. An apparatus as claimed in claim **11** wherein and further comprising:

an annular chamber in fluid communication with the inlet vent and disposed generally concentric with an axis of rotation of the shaft assembly; and

an exhaust port in fluid communication with the annular chamber.

13. An apparatus as claimed in claim **6** wherein the processing bowl comprises a wall boot.

14. An apparatus as claimed in claim **13** wherein the chamber forming member comprises:

a seal retainer cap disposed on a process chamber side of the wall boot, the seal retainer cap including an aperture;

a motor adapter secured with the seal retainer cap on a side of the wall boot opposite the process chamber side, the motor adapter including an aperture coinciding with the aperture of the seal retainer cap, the coinciding apertures being defined by surfaces that form the chamber about the flow generating threads, the motor adapter and the seal retainer cap gripping the boot wall.

15. An apparatus as claimed in claim **14** wherein the seal retainer cap and the motor adapter cooperate to form one or more fluid channels that conduct the flow of fluid provided by the flow generating threads to the exhaust.

16. An apparatus as claimed in claim **6** wherein fluid conducted to the exhaust is exhausted to ambient atmosphere.

17. An apparatus as claimed in claim **6** wherein fluid conducted to the exhaust is exhausted to a containment vessel.

18. An apparatus as claimed in claim **6** wherein fluid conducted to the exhaust is exhausted to a recirculation system.

19. An apparatus for use in processing a microelectronic workpiece, the apparatus comprising:

a processing bowl defining a processing chamber;

a motor drive assembly connected to drive one or more components disposed in the processing chamber, the motor drive assembly comprising

a motor;

a shaft assembly that is connected to be rotated by the motor about an axis of rotation, the shaft assembly having flow generating threads and seal threads at an end of the shaft assembly that is proximate the processing chamber, the flow generating threads being disposed further from the motor than are the seal threads; and

a chamber forming member substantially surrounding the flow generating threads and the seal threads to thereby form a flow chamber about at least a portion of the flow generating threads and about at least a portion of the seal threads,

rotation of the flow generating threads as the shaft assembly is driven by the motor urging a flow of fluid from the processing chamber to an outlet, concurrent rotation of the seal threads assisting in preventing the fluid flow from entering the motor.

20. An apparatus as claimed in claim **19** wherein the seal threads are in the form of a plurality of helical threads.

21. An apparatus as claimed in claim **19** wherein the seal threads are in the form of a plurality of parallel grooves.

22. An apparatus as claimed in claim **19** wherein the shaft assembly comprises:

a drive shaft connected to the motor; and

a seal member disposed about a peripheral portion of the drive shaft and connected for co-rotation with the drive shaft, the seal member including a peripheral surface that includes the flow generating threads.

23. An apparatus as claimed in claim **19** wherein the flow generating threads are in the form of helical threads disposed at the end of the shaft assembly.

24. An apparatus as claimed in claim **19** wherein the chamber forming member comprises one or more fluid channels disposed to receive the flow of fluid provided by the flow generating threads.

25. An apparatus as claimed in **24** wherein the flow generating threads are in the form of helical threads and wherein the one or more fluide channels comprise an inlet vent disposed to receive the flow of fluid as the fluid is deflected from an angled surface of one of the helical threads proximate the inlet vent, the inlet vent being defined by one or more surfaces angled in general alignment with the angled surface of the one of the helical threads.

26. An apparatus as claimed in claim **25** wherein and further comprising:

an annular chamber in fluid communication with the inlet vent and disposed generally concentric with an axis of rotation of the shaft assembly; and

an exhaust port in fluid communication with the annular chamber.

27. An apparatus as claimed in **24** wherein the one or more fluid channels comprise:

an inlet vent disposed to receive the flow of fluid from the flow generating threads;

an annular chamber in fluid communication with the inlet vent and disposed generally concentric with an axis of rotation of the shaft assembly; and

an exhaust port in fluid communication with the annular chamber.

28. An apparatus as claimed in claim **19** wherein the processing bowl comprises a wall boot.

29. An apparatus as claimed in claim **28** wherein the chamber forming member comprises:

a seal retainer cap disposed on a process chamber side of the wall boot, the seal retainer cap including an aperture;

a motor adapter secured with the seal retainer cap on a side of the wall boot opposite the process chamber side, the motor adapter including an aperture coinciding with the aperture of the seal retainer cap, the coinciding apertures being defined by surfaces that form the chamber about the flow generating threads, the motor adapter and the seal retainer cap gripping the boot wall.

30. An apparatus as claimed in claim **29** wherein the seal retainer cap and the motor adapter cooperate to form one or more fluid channels that conduct the flow of fluid provided by the flow generating threads to an exhaust.

31. An apparatus as claimed in claim **30** wherein fluid conducted to the exhaust is exhausted to ambient atmosphere.

32. An apparatus as claimed in claim **30** wherein fluid conducted to the exhaust is exhausted to a containment vessel.

33. An apparatus as claimed in claim **30** wherein fluid conducted to the exhaust is exhausted to a recirculation system.

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